Are the Brown and Harris "Vulnerability Factors" Risk Factors for Depression?

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The Brown and Harris model of depression holds that certain "vulnerability factors" — namely early maternal loss, lack of a confiding relationship, greater than three children under the age of 14 at home and unemployment — can interact with "provoking agents" to increase the risk of depression. The validity of this model has been widely debated, with most of the discussion concerning the interactive nature of the model. There has been relatively little attention paid to the possibility that the "vulnerability factors" may be risk factors for depression. The purpose of this paper is to determine whether the four Brown and Harris "vulnerability factors" are associated with an elevated risk of depression, irrespective of whether they may interact with provoking agents. The analysis contained in this paper utilizes power analyses and confidence intervals. The findings suggest that the lack of a confiding relationship is strongly associated with depression, and that all four of the "vulnerability factors" may be associated with an increased risk of depression.

Key Words: depression, depressive disorder, etiology

INTRODUCTION

Risk factors can be defined as characteristics, behaviors or experiences that increase the probability of developing a negative health status (Slome et al 1986). Knowledge of such factors is important for understanding the etiology of illness and also for the planning of preventative programs. The identification of risk factors is one of the central goals of epidemiological research.

In 1978, Brown and Harris reported the results of a community study of 458 women in the inner London area of Camberwell. The study was concerned with the etiology of depression, and resulted in the elaboration of a model of psychosocial causation of depression. One aspect of this model was the existence of four "vulnerability factors" for depressive illness in women. These factors included three or more children under the age of 14 at home; lack of

an intimate relationship with a husband or boyfriend; lack of employment outside of the home; and, loss of a mother before the age of 11 years. Within the context of the Brown and Harris model of depression, these vulnerability factors were hypothesized to increase the risk of depression in the presence of certain "provoking agents." Hence, this model proposed an interaction between vulnerability factors and provoking agents, with the risk of depression being significantly greater when both were present. Although the validity of the Brown and Harris model has been widely debated (Brown and Harris 1986; Tennant 1985), this topic is beyond the scope of this paper. However, aside from the validity of the model itself, the existence of "vulnerability factors" which may serve in an epidemiological sense as risk factors for depression is of obvious interest and relevance.

The concept of a risk factor for depression is different from the concept of a vulnerability factor, as defined by Brown and Harris. The idea of an interaction with a provoking agent is not directly relevant to the definition

of a risk factor. However, risk factors may interact with one another. For example, cigarette smoking and asbestos exposure are synergistic as risk factors for mesothelioma. According to the Brown and Harris model of psychosocial causation of depression, vulnerability factors may be risk factors for depression, but the chance of depression is greatly increased by the additional presence of a provoking agent.

A number of studies have attempted to replicate the Brown and Harris model. However, most of these have emphasized the interaction of vulnerability factors and provoking agents in their analyses and have given relatively less consideration to the possibility that the vulnerability factors themselves may be associated with an increased risk of depression. However, the existence of such factors as risk factors for depression is of major importance, analogous perhaps to the importance of smoking as a risk factor for lung cancer, or hypertension as a risk factor for cerebrovascular disease. Knowledge of risk factors may help clinicians understand their depressed patients. It may also help in the identification of individuals at risk for depression and in the planning of preventative programs. Identification of risk factors also furthers the scientific understanding of disease processes.

Several attempts at replication of the Brown and Harris model have been published in the past decade. On the whole, these studies have failed to replicate the interactive model. In addition, when these studies have tested for associations between the "vulnerability factors" alone and the occurrence of depression, they have generally failed to find significant associations, ie., Bebbington et al 1984, Brown and Prudo 1981, Campbell et al 1983, and Costello 1982. However, in some instances, significant associations were found. Also, in some cases where no significant associations were found, the studies may have lacked adequate power to detect significant associations. This raises the possibility of type II error, ie., failure to reject the null hypothesis when it is, in reality, false. In other words it is possible that the failure to find an association between potential risk factors and depression in some studies may be due to an error resulting from inadequate statistical power, rather than weak or absent relationships between the potential risk factors and depression. In this context, power refers to the probability of detecting a particular relationship given a certain effect size (or strength of relationship), and the sample size of the study under consideration. Type II error due to inadequate sample size may occur commonly in the medical literature (Freiman et al 1978).

A number of techniques are available for dealing with the possibility of type II error and inadequate power. One technique consists of the generation of post-hoc power estimates (Bird and Hall 1986). Another involves the generation of confidence intervals. Power estimates are useful because they help estimate the probability of type II error. Confidence intervals are useful because they provide a range of plausible values for population parameters, such as the odds ratio, given the data reported in a study.

The purpose of this paper is to re-analyze data from a group of previously published studies in an attempt to determine whether the four Brown and Harris vulnerability factors are potential risk factors for depression. In other words, the study is an attempt to determine whether there is evidence, in this literature, for an association of the four Brown and Harris "vulnerability factors" with depression. The analysis does not attempt to determine whether these factors interact with other factors, nor is the analysis concerned with the validity of the Brown and Harris model of depression. A literature review approach has been chosen because the relevant literature consists of several methodologically homogeneous studies. The major issues have to do with the interpretation of the results in view of confidence intervals and power estimates, as described above. This issue may be more productively approached by an analysis of the existing literature than by conducting another study similar to those already published. In addition to the power estimates and confidence intervals utilized in the analysis, some meta-analytic techniques are also used. Throughout the paper, odds ratios are used as the measure of effect size.

LITERATURE REVIEW

A number of attempts at replication of the original Brown and Harris study used non-clinical samples. In some cases these were community based random samples. In all of these studies, the subjects were divided into cases and non-cases on the basis of structured interviews and the presence or absence of each "vulnerability factor" was determined, also by interview. For the purpose of the analyses in this paper, the literature was reviewed and studies were accepted into the analysis if they: (a) were attempts at replication of the Brown and Harris model, and (b) if similar methods and instruments were used [Present State Examination (P.S.E.) based structured interviews and the Life Events and Difficulties (L.E.D.) interview]. Four such studies were found (Bebbington et al 1984; Brown and Prudo 1981; Campbell et al 1983; Costello 1982) which, when combined with the original Brown and Harris study, composed a literature of five studies. Because of the fairly stringent criteria for admission of studies into this analysis, the number of studies included is quite small. The justification for the use of such stringent entrance criteria in this analysis is that the resulting group of papers are highly homogeneous methodologically. As a result, meta-analytic pooling is a feasible as a part of the analysis. Furthermore, the use of methodologically homogeneous studies facilitates the meaningful comparison of results across the studies. Data were abstracted from each publication (where possible) and put into the form of 2 x 2 contingency tables for each potential risk factor. The results of the data abstraction process are summarized in Table 1. For each potential risk factor, in each study, a p-value was calculated using a chi-square test statistic. The resulting p-values are included in Table 1. The p-values confirm that with the exception of one risk factor, ie., lack of intimacy, the studies have not consistently found significant associations between the potential risk factors and depression.

Table 1

Four "vulnerability factors" as risk factors for depression. The data presented have been a abstracted from the five published studies listed.

Study	Risk Factor (RF)	RF+ Dep+	RF- Dep+	RF+ Dep§	RF- Dep§	p*
Brown,	Parental Loss	7	30	23	359	.004
Harris.	No Intimacy	13	24	39	343	<.001
(1978)	>3 Children	n.a.	n.a.	n.a.	n.a.	
	Unemployed	21	16	150	242	.028
Brown,	Parental Loss	2	14	12	159	.427
Prudo.	No Intimacy	10	6	52	119	.009
(1981)	>3 Children	7	9	21	150	.001
	Unemployed	8	8	51	120	.097
Costello.	Parental Loss	2	36	14	369	.621
(1982)	No Intimacy	12	26	58	325	.009
	>3 Children	2	36	41	342	.290
	Unemployed	22	16	192	191	.362
Campbell,	Parental Loss	n.a.	n.a.	n.a.	n.a.	
Cope,	No Intimacy	14	4	29	63	<.001
Teasdale.	>3 Children	13	5	45	47	.070
(1983)	Unemployed	13	5	50	42	.161
Bebbington,	Parental Loss	1	22	10	137	.655
Sturt,	No Intimacy	17	6	76	71	.047
Tennant,	>3 Children	1	22	10	137	.655
Hurry. (1984)	Unemployed	10	13	49	98	.343

RF+ indicates risk factor present, RF- indicates risk factor absent, Dep+ indicates depression present, Dep- indicates depression absent.

* p-values calculated as chi-square from abstracted data.

Table 2

Power to detect associations between depression and four possible fisk factors in five studies at four hypothetical strengths of association: odds ratio (O.R.) = 1.5, 2.0, 2.5, and 3.0)

Study	Risk Factor	O.R. 1.5	O.R. 2.0	O.R. 2.5	O.R. 3.0
Brown,	Parental Loss	13.6%	30.3%	46.9%	60.7%
Harris.	No Intimacy	16.9%	38.9%	59.4%	74.5%
(1978)	>3 Children	n.a.	n.a.	n.a.	n.a.
	Unemployed	22.4%	52.7%	76.3%	89.4%
Brown,	Parental Loss	9.7%	19.5%	29.7%	39.2%
Prudo.	No Intimacy	12.6%	27.7%	43.3%	57.0%
(1981)	>3 Children	11.5%	24.4%	37.9%	50.1%
	Unemployed	12.6%	27.8%	43.4%	57.1%
Costello.	Parental Loss	10.9%	22.9%	35.2%	46.3%
(1982)	No Intimacy	18.9%	44.5%	66.6%	81.5%
	>3 Children	15.7%	36.2%	55.6%	70.5%
	Unemployed	21.2%	50.4%	73.7%	87.4%
Campbell,	Parental Loss	n.a.	n.a.	n.a.	n.a.
Cope,	No Intimacy	12.4%	27.4%	43.0%	56.7%
Teasdale.	>3 Children	11.3%	24.3%	38.0%	50.4%
(1983)	Unemployed	10.7%	22.6%	35.2%	46.8%
Bebbington,	Parental Loss	9.9%	20.2%	30.8%	40.5%
Sturt,	No Intimacy	13.4%	29.9%	46.8%	61.1%
Tennant,	>3 Children	9.9%	20.2%	30.8%	40.5%
Hurry. (1984)	Unemployed	15.1%	34.7%	53.9%	69.2%

METHOD OF POWER ESTIMATION AND CONSTRUCTION OF CONFIDENCE INTERVALS

The estimation of power for such studies is complex because power depends upon several different factors, including the assumed strength of the underlying relationships, the sample size, the proportion of the population which is depressed, and the proportion of the population which have been exposed to the risk factor. However, if hypothetical values for the odds ratio (which serves as a measure of effect size) are assumed, the expected cell frequencies for a 2 x 2 table of depressed versus non-depressed and risk factor versus no risk factor can be estimated (Fleiss 1981). This was done for the various risk factors in each study at several hypothetical values for the odds ratio (1.5, 2.0, 2.5 and 3.0). Subsequently, a standard formula for estimating the power to detect differences between proportions was applied (Rosner 1986).

Confidence intervals for the observed odds ratios for each risk factor in each study were calculated using an approximate formula (Fleiss 1981; Hennekens and Buring 1987).

RESULTS

The results of the power estimations for each of the studies at the hypothetical odds ratios are presented in Table 2.

One risk factor, the lack of an intimate relationship, showed significant association with depression in each of the studies. The other three risk factors, ie., loss of a mother before the age of 11, greater than 3 children under the age of 14 at home, and unemployment, had inadequate power to detect such associations at low to moderate effect sizes (odds ratio = 1.5 to 2.5). Therefore, the predominantly negative findings in the studies regarding these risk factors are not associated with adequate statistical power to rule out the possibility that these three factors may be risk factors for depression. More specifically, they are all consistent with the possibility that the failure to find significant associations in the negative studies may have been due to type II error.

To determine what sorts of effect sizes are consistent with the published findings in this literature, 95% confidence intervals were estimated for each risk factor in each study (where adequate raw data were published). These are presented in Figure 1. If a factor is a risk factor, then its odds ratio should be greater than one. A perusal of the 95% confidence intervals in the figure reveals that the data for lack of intimacy seem most consistent with an odds ratio of two to five. The other potential risk factors are all consistent with a wide range of possible effect sizes. The findings for each risk factor in each study are consistent with odds ratios of greater than one.

The power estimations and confidence intervals suggest that lack of an intimate, confiding relationship is strongly
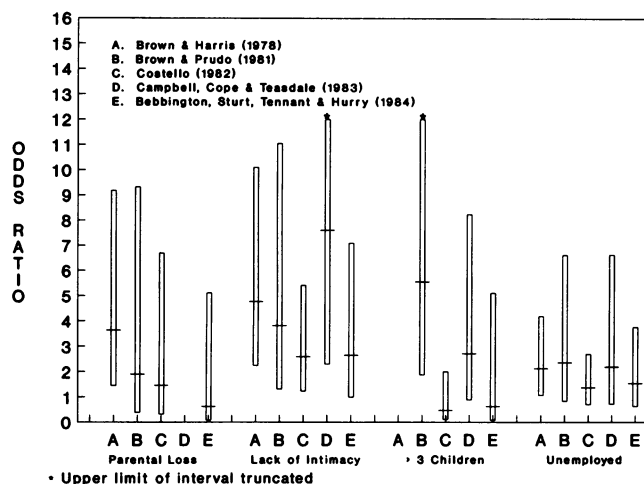
Fig. 1: Odds ratios and 95% confidence intervals for four potential risk factors in five studies (A-E).

associated with depression. The analysis also suggests that the lack of association between the other three potential risk factors and depression reported in this literature does not exclude the possibility that the factors are risk factors. Of course, neither does the analysis prove that these three factors are risk factors. It is reasonable to ask, then, whether the literature suggests the existence of an elevated odds ratio for these possible risk factors. The method used to approach this question is based on meta-analytic techniques. A Mantel-Haenszel pooled estimate of the odds ratio was derived from the contingency tables across the five studies (Rosner 1986). The pooled odds ratios are as follows: loss of a mother before the age of eleven; 2.0; three or more children under the age of 14 living at home; 1.7; lack of an intimate relationship; 3.7;, and unemployment; 1.8. Thus, for each of the potential risk factors the pooled odds ratios point to an association between the risk factor and the occurrence of depression.

DISCUSSION

Analyses of power and the construction of confidence intervals cannot prove that a significant association exists between a risk factor and a disease. Power analyses can only attempt to estimate the probability that a certain study will detect an association, if an association of a given strength exists. Confidence intervals can only describe the range of effect sizes which are plausible given the observed data. However, the results of this analysis point to the possible importance of the four Brown and Harris "vulnerability" factors as risk factors for depression. This finding is of interest because the published studies have generally reported a failure to find significant associations between these factors and depression. However, the low power and wide confidence intervals generated by the data suggest that the failure to find significant associations may be due to type II error. The calculation of 95% confidence intervals for the odds ratios from these studies indicates that despite the

failure to find significant associations in many of these studies, the data are consistent with important associations possibly existing in the populations studied. Estimates for a population parameter, the odds ratio, derived from data pooled across the studies suggest a strong association between the occurrence of depression and the lack of an intimate relationship, and weaker but potentially very important associations between the other three potential risk factors and depression.

It should be noted that the data discussed and analyzed in this paper come from cross-sectional surveys. The presence of the associations suggested by the analysis are not necessarily direct causal relationships. The associations could be due to confounding variables, or in some cases could be causes rather than effects. Also, the risk factors may potentially be related to depression only through other intervening variables (which could include factors that would be regarded as provoking agents in the Brown and Harris model). Such epidemiologic considerations are clearly beyond the understanding provided by the current analysis. However, the analysis does show a tendency for the Brown and Harris vulnerability factors to be associated with the occurrence of depression.

With the exception of lack of intimacy, which has an estimated odds ratio of approximately 3.7, the relevant odds ratios for the other potential risk factors are approximately two, which suggests an approximate doubling of risk for each factor. Such an association may be of significant clinical importance and is, for example, comparable to the odds ratio for smoking as a risk factor for atherosclerosis. Despite the importance of the identification of risk factors in epidemiology and medicine, these associations may have received little attention in the past partly because the relevant studies have focussed on attempting to replicate the interactive nature of the Brown and Harris model. Furthermore, the predominance of negative results in the literature may have discouraged interest in this area. Clearly, because of the importance and utility of medical knowledge about risk factors, these factors should be a focus of future research.

The analyses presented in this paper have not focussed on the possibility of an interaction between the four potential risk factors and provoking agents for depression. As such, the analyses were not intended to evaluate the interactive nature of the Brown and Harris model, and the findings have no bearing on the validity of that model. The analyses can certainly not be regarded as evidence against the interactive model because the associations observed between the four potential risk factors and depression could arise entirely because of interactions with provoking agents. Whatever the actual mechanisms are, the data do suggest the existence of associations between the four vulnerability factors and the occurrence of depression.

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REFERENCES

Bebbington PE, Sturt E, Tennant C, Hurry J (1984). Misfortune and resilience: a community study of women. *Psychol Med* **14**:347-363.

Bird KD, Hall W (1986). Statistical power in psychiatric research. *Aust N Z J Psychiatry* **20**:189-200.

Brown GW, Harris TO (1978). *Social Origins of Depression: A Study of Psychiatric Disorder in Women.* London: Tavistock Publications.

Brown GW, Harris TO (1986). Stressor, vulnerability and depression: a question of replication. *Psychol Med* **16**:739-744.

Brown GW, Prudo R (1981). Psychiatric disorder in a rural and an urban population: 1. Aetiology of depression. *Psychol Med* **11**:581-599.

Campbell EA, Cope SJ, Teasdale JD (1983). Social factors and affective disorder: an investigation of Brown and Harris's model. *Br J Psychiatry* **143**:548-553.

Costello CG (1982). Social factors associated with depression: a retrospective community study. *Psychol Med* **12**: 329-339.

Fleiss JL (1981). *Statistical Methods for Rates and Proportions, 2nd Edition.* New York: John Wiley and Sons, pp 68.

Freiman JA, Chalmers TC, Smith H, Kuebler RR (1978). The importance of beta, the type II error and sample size in the design and interpretation of the randomized control trial. A Survey of 71 "negative" trials. *New Engl J Med* **299**:690-694.

Hennekens CH, Buring SL (1987). *Epidemiology in Medicine.* Boston: Little, Brown and Company, pp 252-257.

Rosner B (1986). *Fundamentals of Biostatistics.* Boston: Duxbury Press, pp 325.

Slome C, Brogan D, Eyres S, Lednar W (1986). *Basic Epidemiological Methods and Biostatistics: A Workbook.* Belmont, California: Jones and Bartlett Incorporated, pp 309.

Tennant C (1985). Female vulnerability to depression. *Psychol Med* **15**:733-737.